FIG. 1 – FOURIER TRANSFORM IR (FTIR) MICHELSON INTERFEROMETER (BACKGROUND ART)

100

140 – FIXED MIRROR

130 – BEAM SPLITTER

150 – MOVING MIRROR

RECOMBINED BEAMS CREATE INTERFEROGRAM ON DETECTOR

110 – IR SOURCE

120 – SAMPLE

160 – IR DETECTOR

TO PROCESSOR
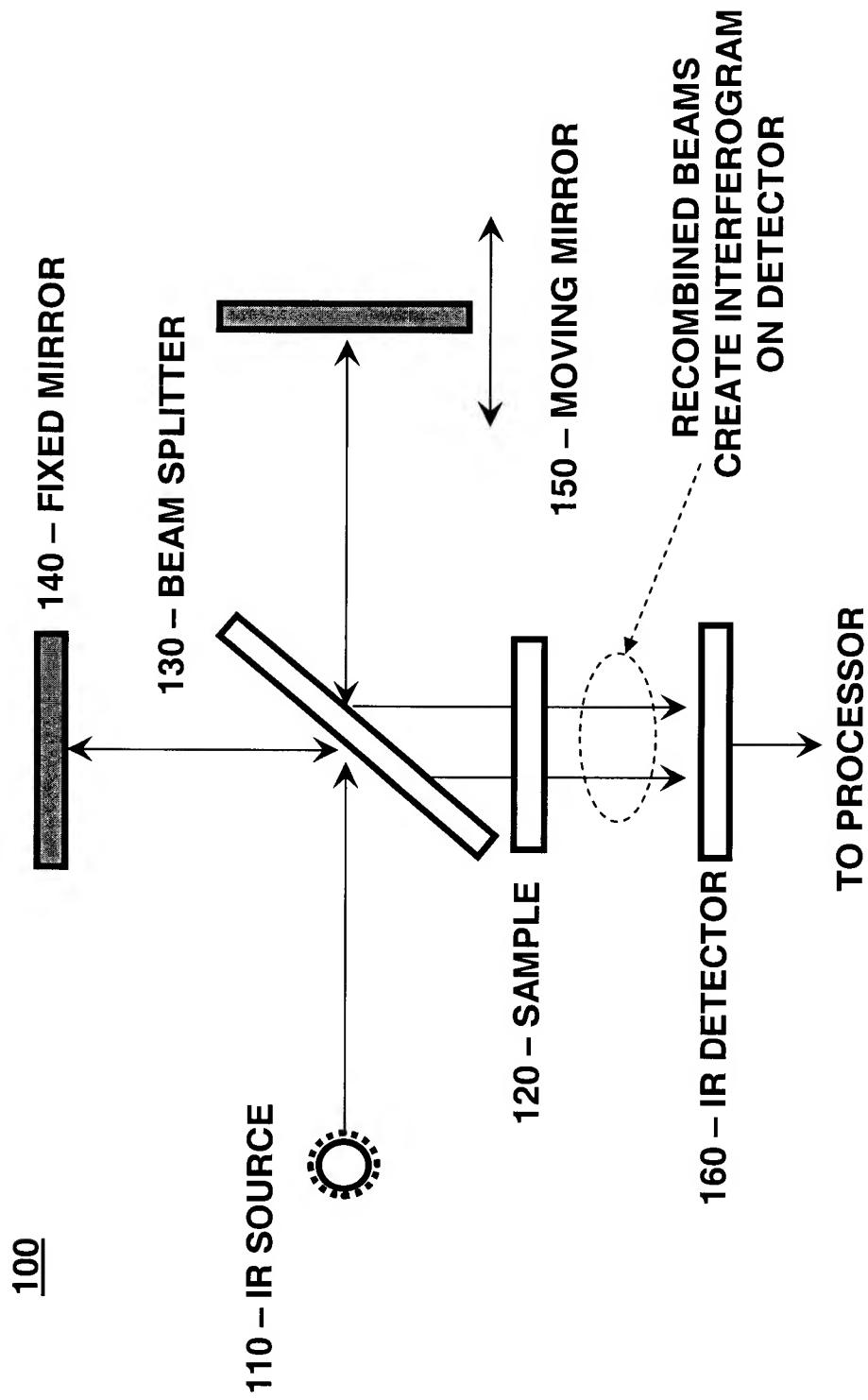
FIG. 2
INTERFEROMETRIC SPECTROPSCOPY USING NO MOVING PARTS
(BACKGROUND ART)

SOURCE

BEAM SPLITTER

OPT PATH "B"

OPT PATH "A"

SAMPLE

FOCAL PLANE ARRAY

POWER SPECTRUM

FOURIER TRANSFORM

IMAGING

IMAGING

IMAGING

IMAGING

SOURCE

BEAM SPLITTER

OPT PATH "B"

OPT PATH "A"

SAMPLE

LINEAR ARRAY
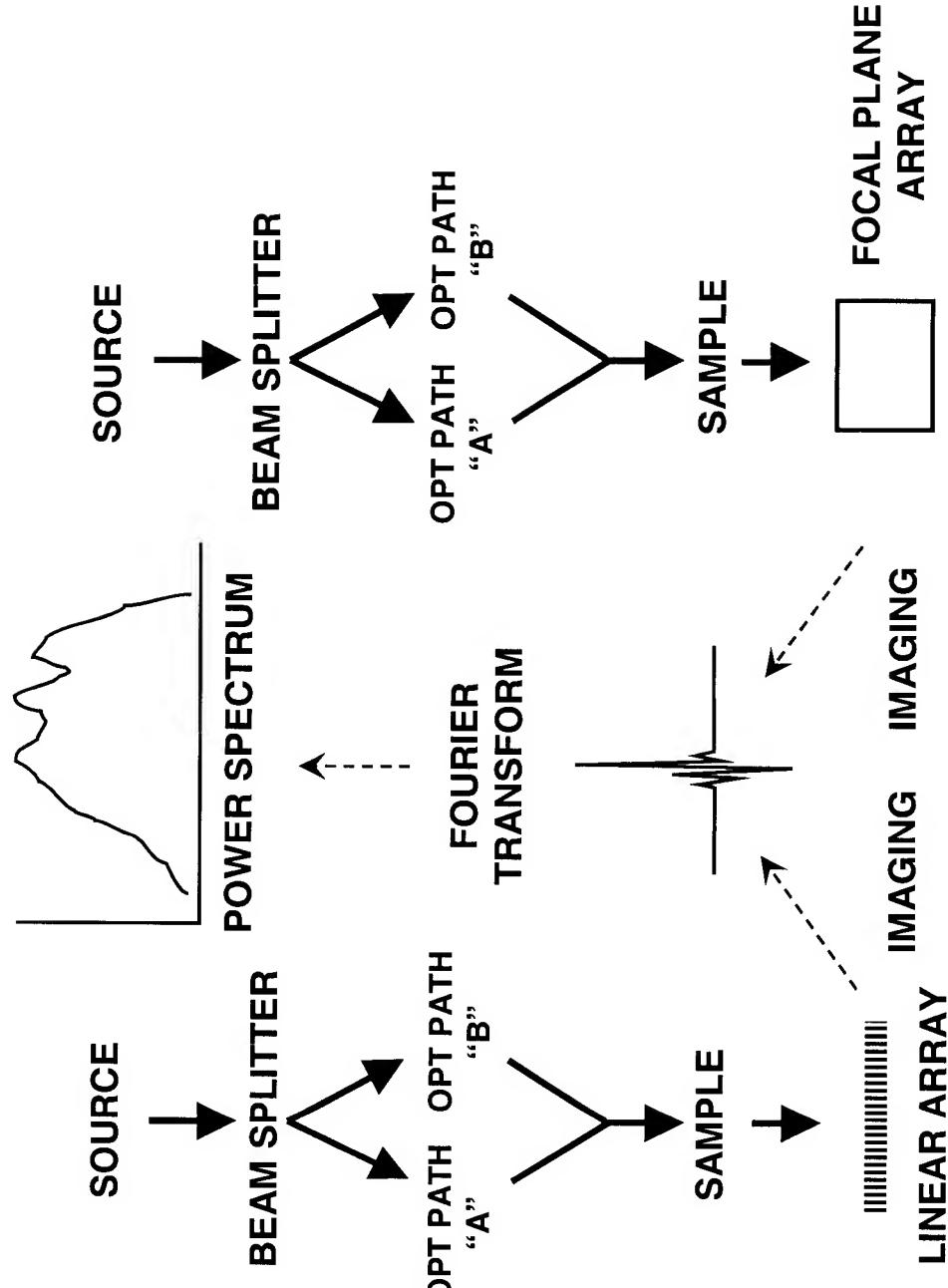
FIG. 3A
NON-INTERFEROMETRIC IR SPECTROSCOPY USING NO MOVING PARTS

300

310 IR SOURCE

320 ADJUSTABLE APERTURE

330 SAMPLING ACCESSORY

340 MIRROR

350 OPTICALLY DISPERSIVE ELEMENT

342 MIRROR

370 IR FPA DETECTOR

360 FOCUSING OPTICS

380 PROCESSOR

390 DISPLAY DEVICE
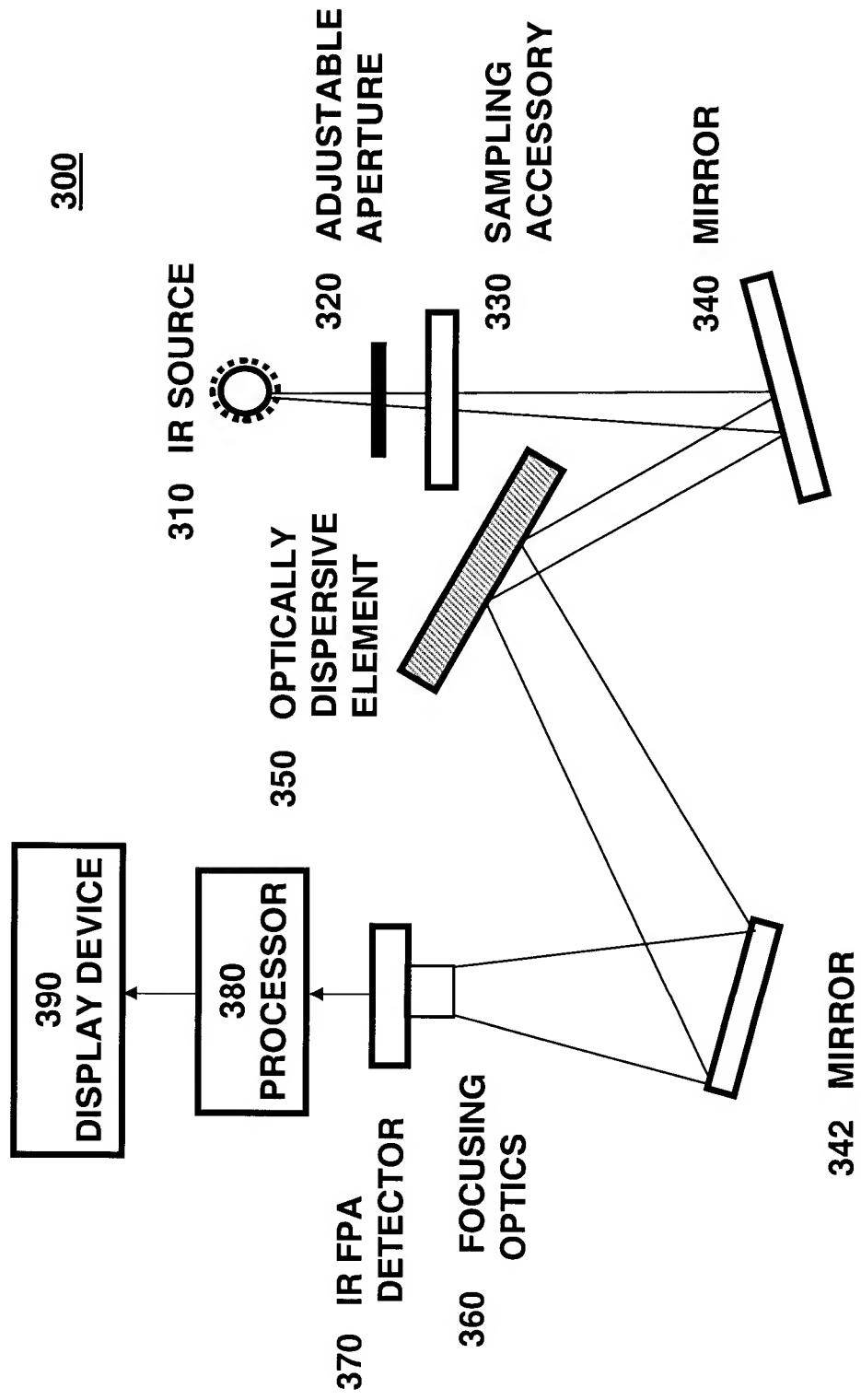
FIG. 3B
MULTIPLE SOURCES/SAMPLES

300'

310 IR SOURCE

320 ADJUSTABLE APERTURE

330 SAMPLING ACCESSORY

340 MIRROR

311 2ND IR SOURCE

320' ADJUSTABLE APERTURE

331 SAMPLING ACCESSORY

350 OPTICALLY DISPERSIVE ELEMENT

341 MIRROR

342 MIRROR

360 FOCUSING OPTICS

370 IR FPA DETECTOR

380 PROCESSOR

390 DISPLAY DEVICE
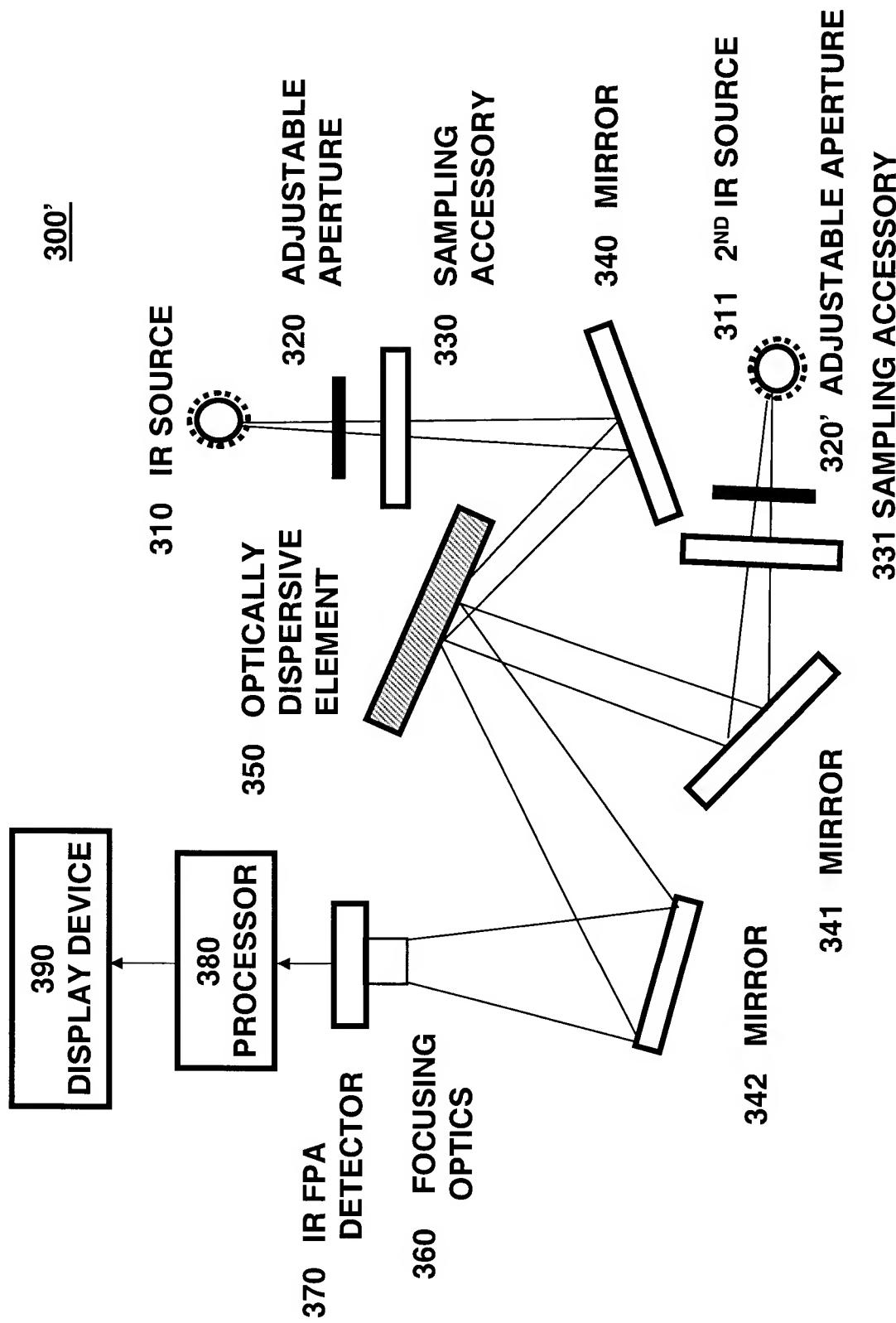
FIG. 3C

SPATIAL MULTIPLEXING OF MULTIPLE BEAMS

BEAM 3, 4...

332

350 OPTICALLY DISPERSIVE ELEMENT

331

BEAM 1
E.G., 310

SAMPLING ACCESSORIES
330, 331, 332 (OR POLARIZER)

BEAM 2
E.G., 311

330

FPA IMAGE

370 IR FPA

340
BEAM 1
COLLECTION
MIRROR

341
BEAM 2
COLLECTION
MIRROR
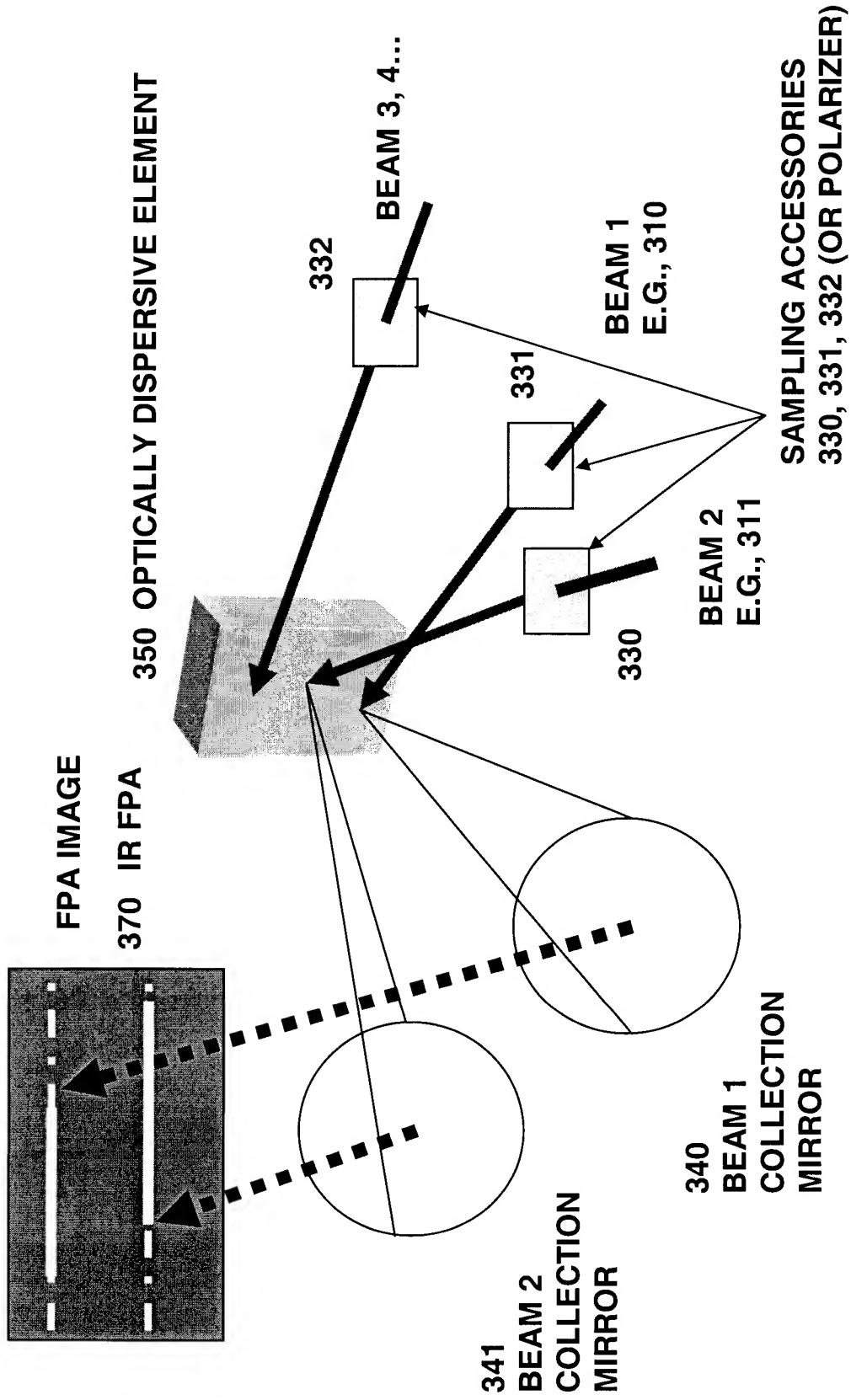
FIG. 3D
SAMPLING WITH POLARIZED LIGHT

335 POLARIZER (0°)

BEAM 1 E.G., 310

336 POLARIZER (90°)

BEAM 2 E.G., 311

350 OPTICALLY DISPERSIVE ELEMENT

330 SAMPLING ACCESSORY

FPA IMAGE

370 IR FPA

340 BEAM 1 COLLECTION MIRROR

341 BEAM 2 COLLECTION MIRROR

$$\text{DICHROIC RATIO} = \frac{|\overleftrightarrow{\mathbf{E}}|_{\text{POLARIZED BEAM 1}}}{|\overleftrightarrow{\mathbf{E}}|_{\text{POLARIZED BEAM 2}}}$$

FIG. 4 – PELLIN-BROCA PRISM IMPLEMENTATION

400

480 PROCESSOR

470 IR FPA DETECTOR

360 FOCUSING OPTICS

450 PELLIN-BROCA PRISM (ZnSe)

LIGHT IS INCIDENT AT BREWSTER ANGLE TO MINIMIZE REFLECTION LOSS

444 CONVEX AU MIRROR

442 CONCAVE AU MIRROR

420 ADJUSTABLE APERTURE

440 OFF-AXIS PARABOLIC AU MIRROR

410 IR FIBER

FIG. 5

ZnSe REFRACTIVE INDEX DISPERSION AND OPTICAL REFRACTION
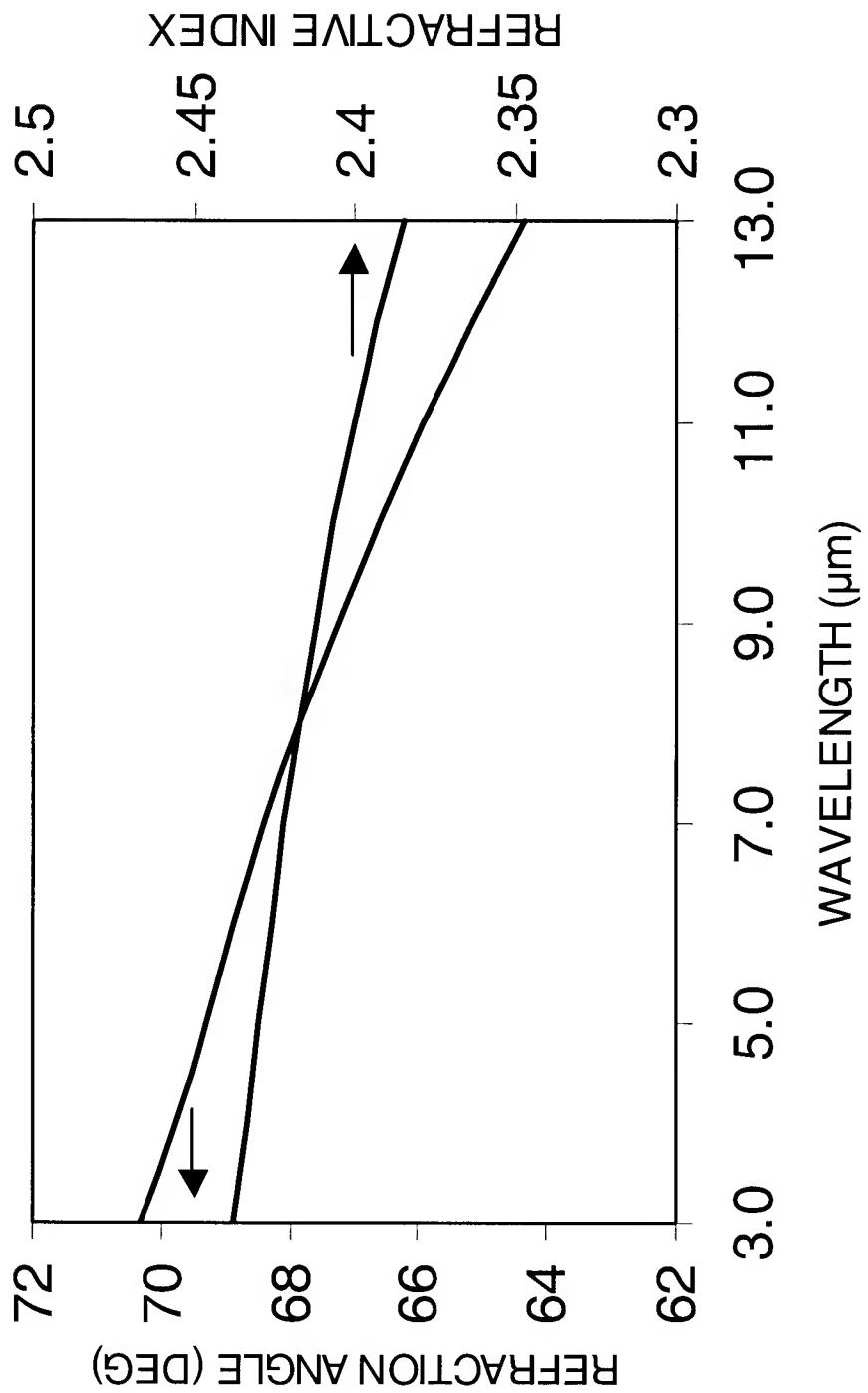
PELLIN-BROCA PRISM IMPLEMENTATION

# FIG. 6
CONFIGURATION FOR REAL-TIME BACKGROUND CORRECTION

SAMPLE TROUGH

REFERENCE TROUGH

THIN TEFLON® BARRIER
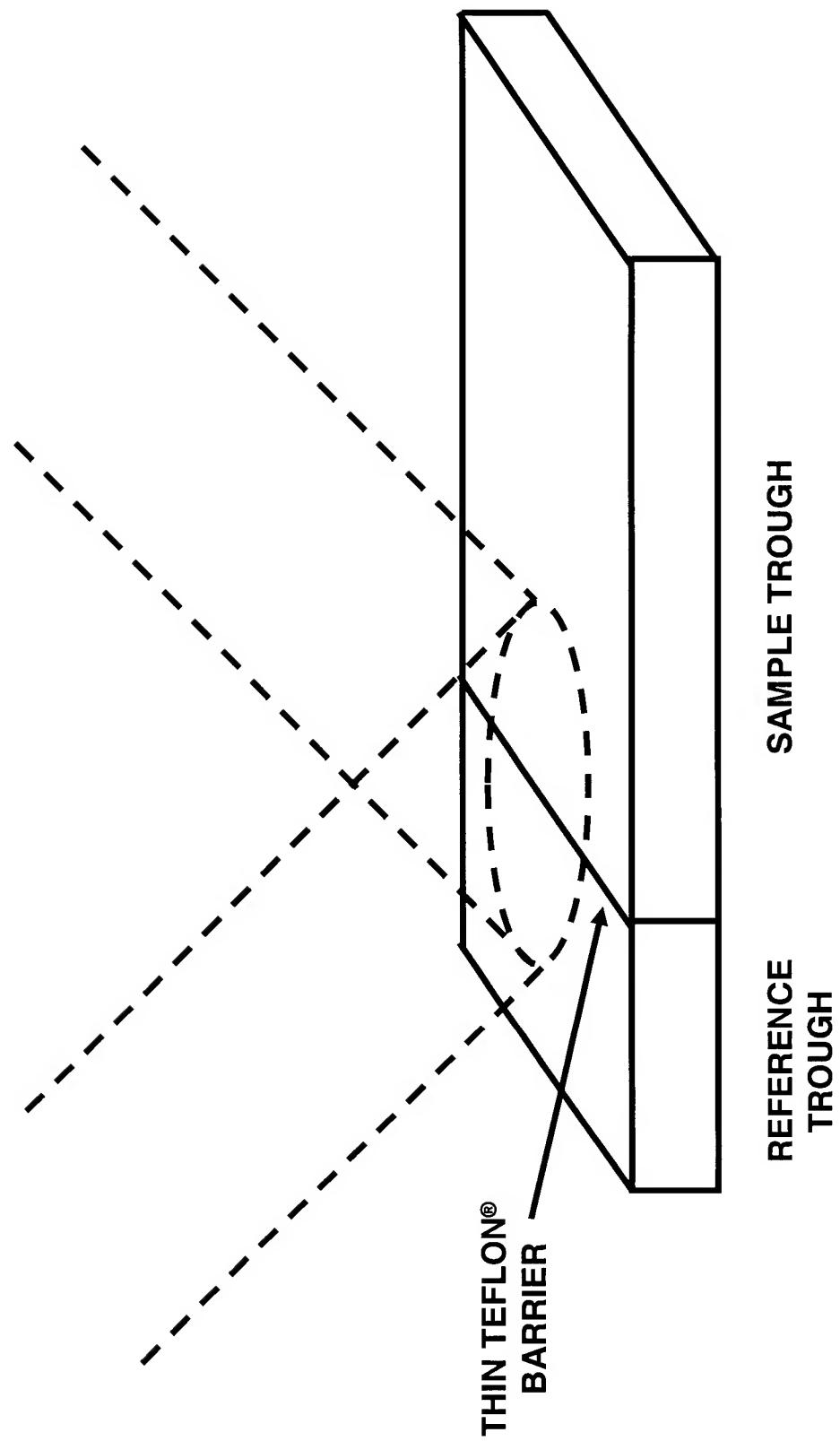
FIG. 7
MEASURING MULTIPLE ANGLES OF INCIDENCE

IR LIGHT

IR LIGHT

IR LIGHT

AQUEOUS SUBPHASE

PLANE MIRROR

TO IR FPA
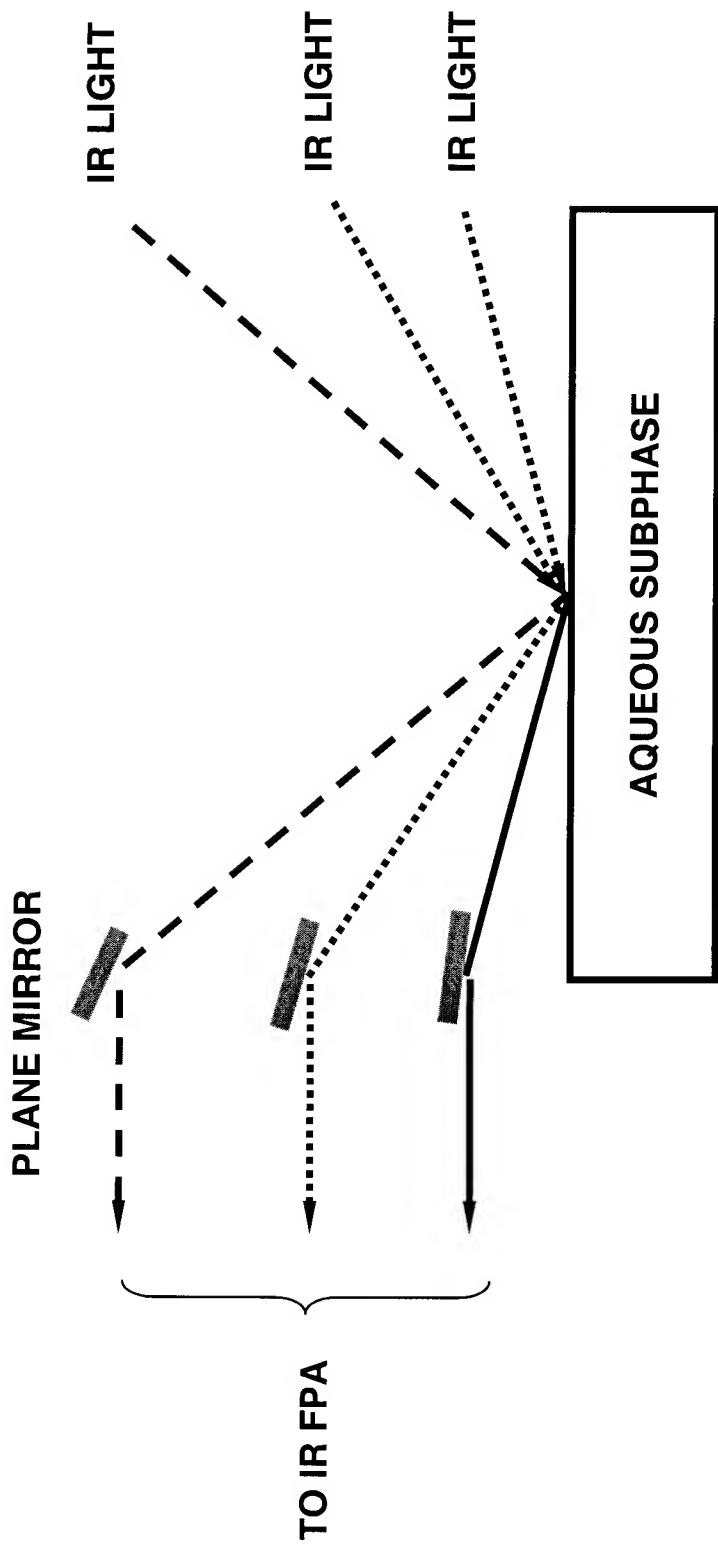
FIG. 8

STRATIFIED THREE-PHASE SYSTEM

$\tilde{n}_1 = n_1 + ik_1$ ambient

$\tilde{n}_2 = n_2 + ik_2$ thin film

$\tilde{n}_3 = n_3 + ik_3$ substrate

$i = \sqrt{-1}$

$E_\parallel$

$E_\perp$

θ

d

x

z

y
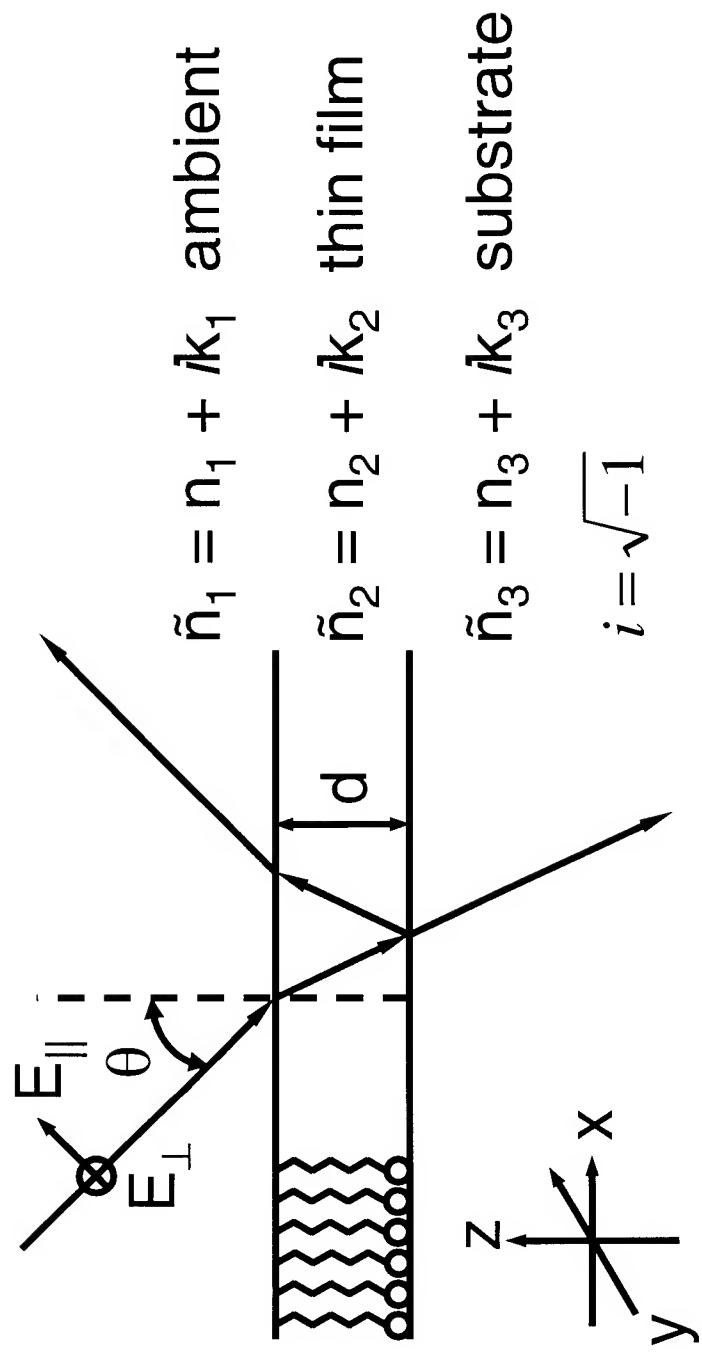
FIG. 9

REFLECTION/REFRACTION MEASUREMENT FOR DETERMINING OPTICAL CONSTANTS OF A THIN FILM

PLANE MIRROR

θ_1

θ_2

E

DIRECTED TO ENTRANCE SLIT (AND IR FPA)

E´

DIRECTED TO ENTRANCE SLIT (AND IR FPA)

PLANE MIRROR (ADJUSTABLE)

DIELECTRIC SUBSTRATE PLACED IN SAMPLE POSITION
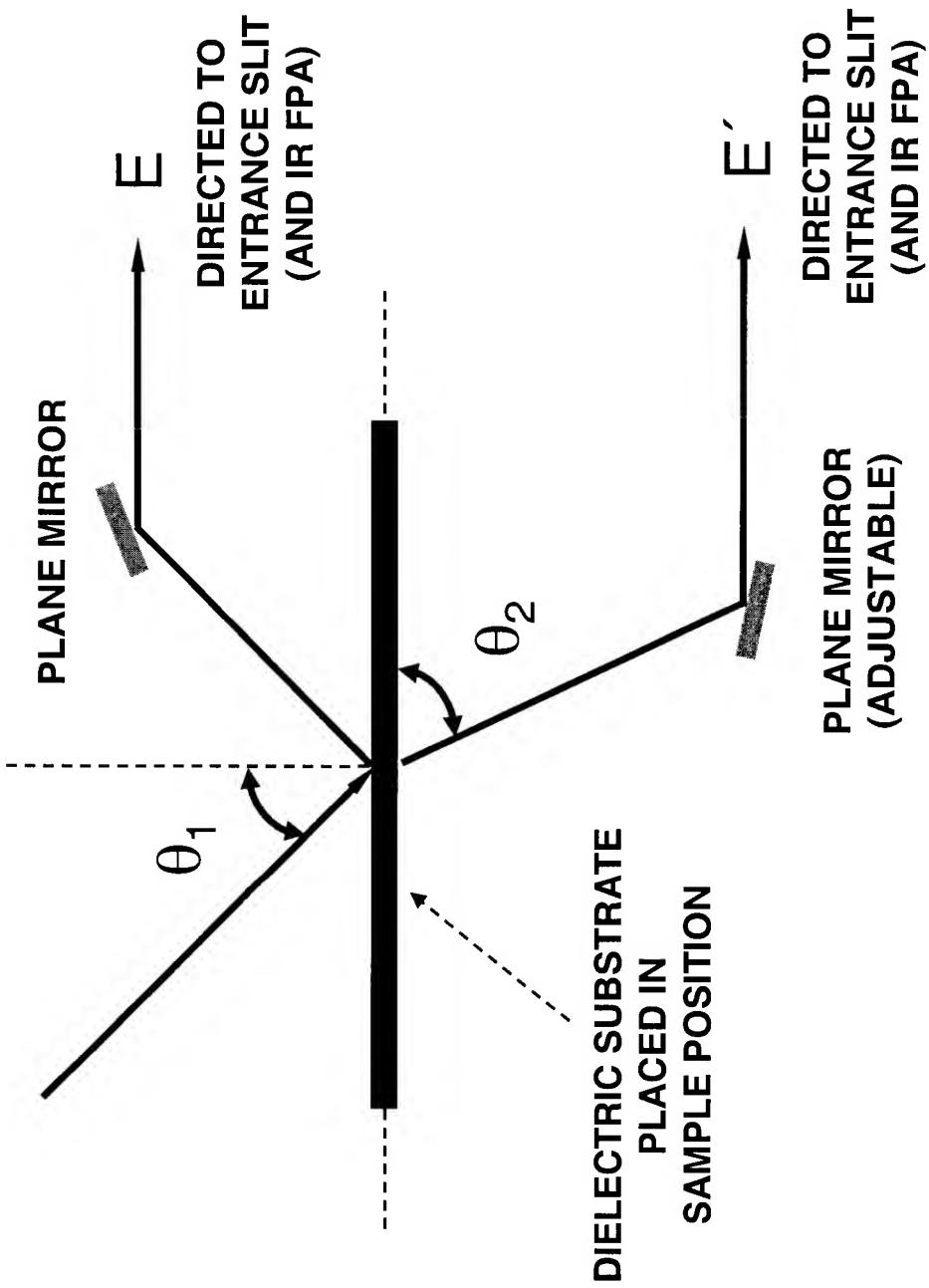
FIG. 10
POLARIZATION MODULATION INFRARED REFLECTANCE-ABSORBANCE SPECTROSCOPY (CONVENTIONAL PM-IRRAS USED WITH FTIR)

SINGLE ELEMENT DETECTOR

FOCUSING OPTICS

ZnSe PHOTOELASTIC MODULATOR

REFLECTED FTIR BEAM

$V_o \cos(\omega t)$

WIRE GRID POLARIZER

FTIR BEAM

LANGMUIR FILM BALANCE

SUBSTRATE
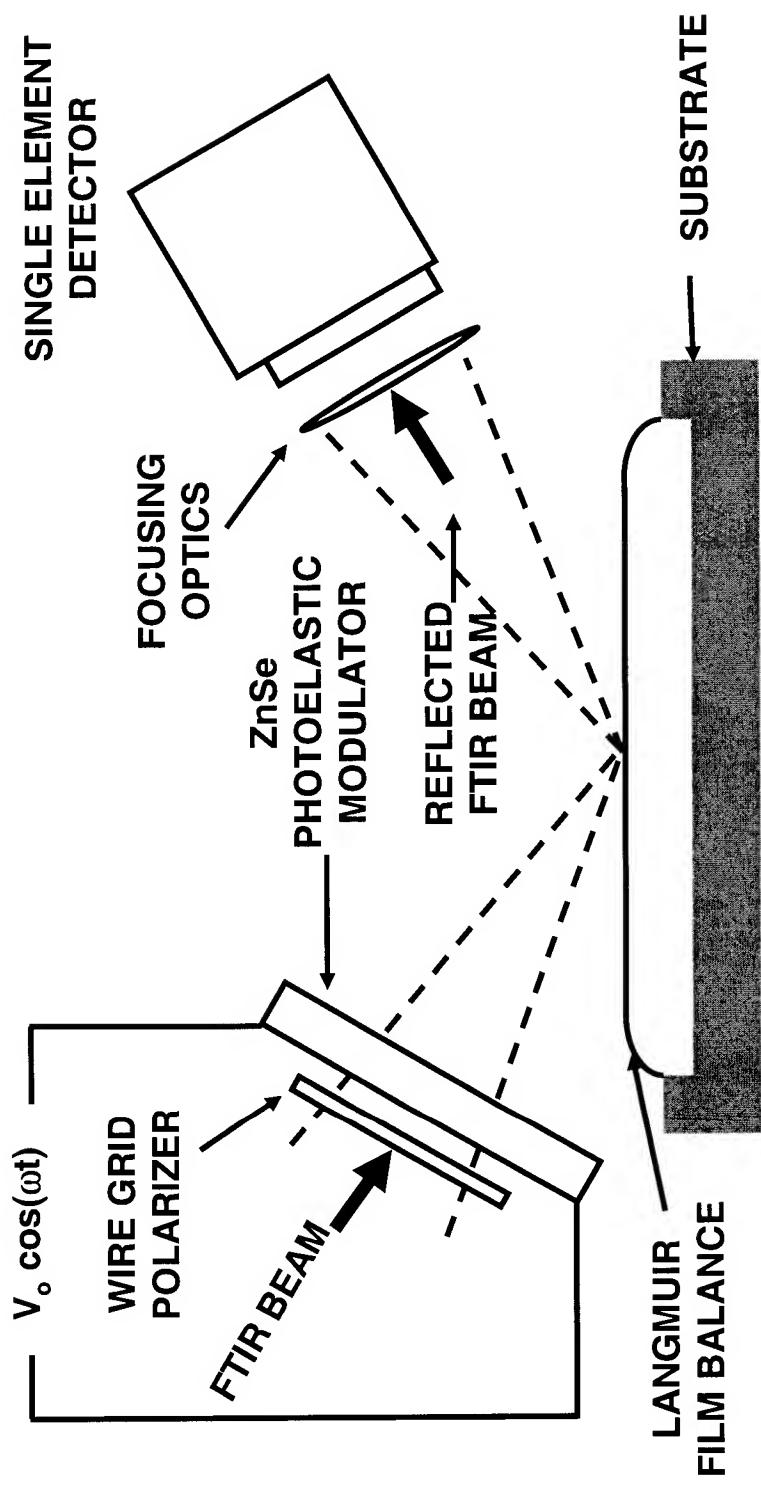
FIG. 11

PLANAR ARRAY INFRARED REFLECTANCE-ABSORBANCE SPECTROSCOPY (PA-IRRAS)

DISPLAY

PROCESSOR

PAIR DETECTOR

LANGMUIR FILM BALANCE

FOCUSING OPTICS

REFLECTED IR BEAMS

POLARIZED IR BEAMS

335 POLARIZER (0°)

UNPOLARIZED IR

336 POLARIZER (90°)

SUBSTRATE